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(54) **Method for selecting stopping positions of reels in a gaming machine**

Verfahren zur Bestimmung der Anhaltelagen der Walzen einer Spielmaschine

Méthode pour sélecter des positions d'arrêt des roues d'une machine à sous

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Description

Background and Summary of the Invention

[0001] The present invention generally relates to gaming apparatus and, more particularly, to electronic reel-type slot machines having a plurality of reels rotatable about a common axis. In a typical reel-type slot machine, a payoff is made to a player when a winning set of symbols is displayed on the pay line(s) of the machine. To start play, a button is pushed or a handle is pulled to initiate rotation of the reels.

[0002] In one type of design, the angular positions of the reels, after they have been stopped, is detected and the appropriate payoff amount, if any, is calculated and paid to the player. Another approach in modern machines uses a random number generator to select the symbols to be displayed on the pay line(s). The payoff is then determined based on a pay table which contains payoff amounts for the various winning symbol combinations. Payoff amounts provided by either approach are limited because there is a fixed limit on the probability of obtaining the maximum payoff, which is the reciprocal of the number of reel stop positions per reel raised to the power of the number of reels.

[0003] Accordingly, it is desirable for manufacturers of reel-type slot machines to provide new ways to increase reel-type slot machine payoff values while maintaining adequate game revenue for the operator. As the payoff amounts increase, player interest in the game is fostered which leads to maximized game revenue.

[0004] One method of increasing payoff values in a prior art electronic slot machine design is to employ a "virtual reel". According to this method, a plurality of numbers are assigned to most of the physical reel stop positions and at least one number is assigned to every physical reel stop position. In this way, the chances of winning the larger payoffs can be decreased by assigning these stop combinations to fewer numbers.

[0005] Such a "virtual reel" system is described in US patent number 5102134 , where two random number selectors are employed, one to select numbers on a theoretical reel strip, and another to decide between physical reel locations if pre-assigned random numbers representing jackpot possibilities are chosen by the first random number generator.

[0006] EP-A-0391667 describes a slot machine in which decisions on winning hits are also taken by a random number generator. The output of a first random number generator is fed to a first judgement section which decides if a winning combination is possible, and if so, the results of a second random number generator are used to determine the type of winning selection.

[0007] The present invention provides an alternative method for increasing payoff levels in electronic reel-type slot machines by the provision of a method of selecting symbol combinations to be displayed on the payline or lines of a multi-reel slot machine.

[0008] The method comprises the steps of providing a symbol look-up table in a memory device either for each reel or for a combination of reels, the or each look-up table being arranged in a tree branch structure containing tiers, each tier comprising nodes, each node comprising either a terminal node or a descending node which leads to a lower tier, and at least one tier reached via a descending node from a higher tier, said at least one tier also including a descending node leading to a lower tier, storing the symbol or symbols to be displayed in the corresponding look-up table at terminal node locations within the tree branch structure and randomly selecting a single node in each tier which is reached, and controlling the reels to display the symbol or symbols stored in any selected terminal node, wherein the symbols are stored at terminal node locations corresponding to desired pay-off probabilities determined by the positions of storage locations within the or each tree branch structure.

[0009] The odds of obtaining a particular winning symbol set can be "dialed in" by assigning each possible reel stop combination to a unique terminal node (position) in a random number fractional branching tree. The tree comprises a main tier, a plurality of lower tiers and a plurality of terminal nodes. Each of the tiers has a number of entries which lead either to a lower tier or to a terminal node.

[0010] During game play, one of the entries on the main tier is randomly selected by the game microprocessor. If the randomly selected entry leads to a lower tier, then one of the entries on that tier is randomly selected. This selection process continues for each successive tier until a terminal node is selected. One reel stop combination is assigned to each terminal node. The combination assigned to the selected terminal node is then displayed on the pay line(s) of the slot machine. A payoff is made to the player if the combination displayed corresponds to a winning symbol combination in a posted pay table.

[0011] In an alternate embodiment of the invention, one fractional branching tree is utilized for each reel strip, each tree having a main tier, a plurality of lower tiers and a plurality of terminal nodes. All of the symbols for each reel are assigned to unique terminal nodes in the fractional branching tree corresponding thereto. To display a reel stop combination on the pay line(s) of the slot machine, the selection process described above is used to randomly select a terminal node and the symbol assigned thereto for each of the reels. The selected combination is displayed and a payoff is made if it corresponds to a winning symbol combination in a posted pay table.

Brief Description of the Drawings

[0012] Figure 1 shows a typical electronic reel-type slot machine which may incorporate the present invention.

[0013] Figure 2 illustrates one example of three reel "strips" containing symbols positioned at the stop positions.

[0014] Figure 3 is a block diagram of a control system for the present invention.

[0015] Figure 4 is a table showing the payoffs and desired odds of obtaining a winning symbol set for the reel strips of Figure 2.

[0016] Figure 5 illustrates a first embodiment of a fractional branching tier system of the present invention.

[0017] Figure 6 is a computer flow diagram illustrating a preferred embodiment of the invention.

[0018] Figure 7 illustrates a second example of three reel "strips" containing symbols positioned at the stop positions.

[0019] Figure 8 is a table showing payoffs and desired odds of obtaining a winning symbol set for the reel strips of Figure 7.

[0020] Figure 9 illustrates a preferred embodiment of a fractional branching tier system of the present invention.

[0021] Figure 10 illustrates one example of three reel "strips" containing symbols positioned at the stop positions for an alternate embodiment of the invention.

[0022] Figure 11 is a table showing the payoffs and the odds of obtaining a winning symbol set for the reel strips of Figure 10.

[0023] Figure 12 illustrates an alternate embodiment of a fractional branching tier system of the present invention.

[0024] Figure 13 is a computer flow diagram illustrating the alternate embodiment of the invention presented in Figures 10-12.

Detailed Description of the Preferred Embodiment

[0025] Referring to Figure 1, an electronic reel-type slot machine 10 is illustrated. Slot machine 10 includes a handle 12, a coin slot 14, payout trough 22 and reels, each having a plurality of stop positions thereon. Each reel includes a system of symbols which are used to display an outcome of a game which is played on slot machine 10. In the illustrated embodiment, slot machine 10 includes three slot reels 16, 18 and 20, each of which has eighteen stop positions each of which corresponds to a symbol. The symbols form combinations which correspond to a pay table displayed to the player.

[0026] It must be noted that slot machine 10 can incorporate any number of reels and that the reels can include any reasonable number of stop positions. Any system of symbols can be utilized a long as there is one symbol, which may include a "blank" symbol, corresponding to each stop position on each reel. When a coin is inserted, the game start button and/or handle is enabled. By pushing the start button or pulling the handle, the player causes the microprocessor control system to spin the reels in an attempt to win money if a winning set of symbols is chosen and displayed on the pay line 24.

[0027] Figure 2 illustrates an example of three reel "strips" which can be attached to reels 16-20. Each of the reel strips contain a system of symbols as discussed above and, in this example, has eighteen discrete physical stop positions at which one of the symbols is displayed. It should be noted that duplicate symbols can be employed on each reel. In the illustrated embodiment, reel one displays two "7s," two triple bars, four double bars, three single bars and seven blanks; reel two displays three "7s," two triple bars, two double bars, four single bars and seven blanks; and reel three displays two "7s," three triple bars two double bars, four single bars and seven blanks.

[0028] Figure 3 is a block diagram of a control system suitable for practicing the present invention. Coin detector 24 sends a signal to microprocessor 26 when a coin is inserted into coin slot 14. The microprocessor then randomly selects the symbol set to be displayed on the pay line. If a player wins, then microprocessor 26 signals the conventional coin mechanism 28 to dispense a payoff to the player via coin payout trough 22.

[0029] Reel motor and step controller 30 rotates the reels 16-20 in response to a signal from microprocessor 26. The signal is generated after a coin input and player operation of the handle 12 or the start button. Controller 30 stops the reels at positions determined by the microprocessor such that the reels display three symbols on the pay line 22.

[0030] During the reel spin, microprocessor 26 randomly selects one of the reel stop combinations for display on the pay line. To ensure that the selected reel stop combination is displayed, detector 32 provides feedback signals to microprocessor 26 which are representative of the rotational position of each reel relative to pay line 22. Feedback of this type is utilized in accordance with well known techniques in this art.

[0031] Figure 4 shows a symbol table which lists the winning sets of symbols A-F and the losing sets of symbols G that can be displayed on pay line 22 for the reel strips of Figure 2. Also listed in Figure 4 are the number of physical reel stop combinations and the desired win percentages which correspond to the symbol sets A-G. The odds of obtaining a particular symbol set can be controlled by assigning each possible reel stop combination to a unique terminal node in a random number branching tree. The location in the tree affects the likelihood of the symbol combination being selected. By way of example, the desired odds listed in Figure 4 are implemented by the fractional branching tree 38 of Figure 5.

[0032] Branching tree 38 includes a plurality of tiers 40-54 having level values of 0.10 to 0.00001 and a plurality of entries which lead either to lower tiers or to terminal nodes. The tree is a conceptual device which is used to explain the method of the invention. In actuality, each reel stop combination is stored in a ROM memory look-up table corresponding to its terminal node location

in tree 38. Each one of the possible reel stop combinations is assigned only once in the tree structure and thus to only one memory location in ROM 34.

[0033] The odds for each of the symbol sets A-G, as listed in Figure 4, may be calculated from the tree as follows. For each tier in tree 38, the number of terminal nodes associated with a particular symbol set is multiplied by that tier's level value. These numbers are then summed to compute the odds.

[0034] For example, the desired odds of obtaining three triple bars, symbol set B, is .00180. Referring to Figure 5, one "B" is placed at tier 46 and eight "B" are placed at tiers 50 and 52. Thus, the desired odds of obtaining three triple bars is (1 * .001) + (7 * .0001) + (1 * .0001) = .0018.

[0035] The third term in the calculation requires explanation. It relates to the sub-tier 51 dropping from tier 50. Note that Figure 4 requires 12 unique ways to display three triple bars. To include all of these combinations and still obtain the desired odds, it is necessary to lower one of the B combinations to a sub-tier in which all of the nodes are set B. The remaining number of nodes in the sub-tier is equal to the number of combinations not used in setting the odds. Thus, sub-tier 51 has four nodes set to B.

[0036] If the entry leading to the sub-tier 51 is selected, the probability of obtaining a B combination is 1.0, the only question being which B combination. Microprocessor 26 randomly selects one of the nodes of the sub-tier to determine which reel stop combination is displayed on the pay line. A similar exercise is employed to implement the probabilities for each of the other symbol groups A and C-G.

[0037] It should be noted that the implementations of the Figure 5 embodiment is accomplished principally using decimal tiers. That is, only ten entries per tier. The use of sub-tiers of varying size, each sub-tier having a probability of 1 for the assigned symbol set, permits the use of all possible reel stop combinations so that no combinations of stop positions need be used or stored in memory more than once. Thus, for example, to display three sevens in twelve unique ways without changing the odds, a sub-tier 159, having three terminal nodes, one for each additional reel stop combination for displaying three sevens, is provided in place of an "A" combination on tier 54.

[0038] Note that the desired odds could be implemented without the use of sub-tiers. In that case, however, not all of the possible combinations of the symbol sets would be displayed. As it is desirable to be able to display each possible combination for a symbol set, the use of sub-tiers is preferred.

[0039] Referring to Figure 6, a computer flow diagram is shown which illustrates the steps executed by microprocessor 26 to select a reel stop combination to be displayed on the pay line. The steps illustrated in Figure 6 are stored as a computer program in read only memory 34 which is executed by microprocessor 26 when the game is played. Current game data is stored in a random access memory (RAM) 36. Figure 6 is a flow diagram which illustrates the essential program steps of the invention permitting it to be implemented on any type of computer system desired.

[0040] The program begins at start step 38. The random number generator function of microprocessor 26 is used to randomly select one of the entries on the main tier 40 of the branching tree (steps 58-64). With reference to the branching tree of Figure 5, microprocessor 26 randomly selects an integer from 1 to 10 (or 0 to 9) which is used to select one of the ten entries on the main tier 40. If the selected entry is not a terminal node, step 66, then the program drops to the next lower tier (step 68) and repeats steps 58-64 until a terminal node is selected.

[0041] If the selected entry is a terminal node, the unique reel stop combination assigned thereto is displayed on the pay line and the appropriate payoff, if any, is determined, step 70. The payoff amounts are stored in a look-up table in ROM 34 for each of the winning symbols sets A-F (Figure 4). The reels which spin while the selection process is implemented (or spin after selection, as desired) are stopped to display the selected reel stop combination and the appropriate award is paid (steps 72-76).

[0042] Figure 7 illustrates a second example of three reel "strips" which can be attached to reels 16-20. The winning sets of symbols A-F and the losing sets of symbols G that can be displayed on pay line 22, the corresponding payoffs and the desired win odds are listed in the table shown in Figure 8.

[0043] Figure 9 illustrates a second embodiment of a fractional branching tree which implements the desired odds for the example of Figures 7 and 8. For clarity, the number of entries on each tier leading to terminal nodes or to lower tiers is labeled in the form 1/X (1 out of X) where X is the number of entries for the tier. The number of reel stop combinations for a given symbol set located on a tier is labeled directly below the tier in parenthesis, if numerous. The tiers have different values of X as necessary to implement each possible reel stop combination for a given symbol set at the desired odds.

[0044] The use of variable length tiers, particularly for the lower tiers, allows the odds to be precisely dialed in with a minimum number of iterations of steps 60-66 (Figure 6). The desired odds of obtaining a particular set of symbols requires only a minimum number of drops to successive tiers from the main tier. For example, the desired odds of obtaining three triple bars (Group B in Figure 8) can be implemented by repeating steps 60-66 three times. Thus, the desired odds (.001818) is implemented by dropping from tier 78 to sub-tier 88 via tier 80.

[0045] More specifically, if the RNG function selects the corresponding entry of tier 78 (the .1 level), a drop is made to tier 80 (the .01 level). Another iteration of the RNG cycle could result in a further drop to sub-tier 88. Sub-tier 88 has 22 terminal nodes of which four repre-

sent the four possible reel stop combinations for displaying three triple bars. Thus, the designation B(4) is shown at sub-tier 88. The odds of selecting any one of the B group terminal nodes equals 1/10 * 1/10 * 4/22 = .001818.

[0046] Similarly, the desired odds for obtaining three double bars, group C, is implemented by dropping to sub-tier 100 via tiers 78, 80 and 98. The desired odds of .0018 are obtained by assigning one of the eight possible reel stop combinations to tier 98 and the remaining seven combinations to sub-tier 100. Thus, the desired odds equal (1/10 * 1/10 * 1/10) + (1/10 * 1/10 * 1/10 * 7/9) = .001 + .000777 = .001777.

[0047] Calculations similar to those illustrated above can be used to implement the desired odds for the remaining sets of symbols resulting in the tree structure of Figure 9. After all of the odds for the winning sets of symbols are implemented, the remaining terminal nodes in the branching tree are "filled out" with losing reel stop combinations. Thus, the desired odds of obtaining a losing symbol set, Group G in Figure 8, equals (1/10 * 7) + (1/10 * 1/10 * 5) + (1/10 * 1/10 * 5/10) + (1/10 * 1/10 * 18/22) + (1/10 * 1/10 * 75/77) + (1/10 * 1/10 * 3) + (1/10 * 1/10 * 3) + (1/10 * 1/10 * 1/10 * 6) + (1/10 * 1/10 * 1/10 * 2/9) = .839144.

[0048] Figure 10 illustrates an alternate embodiment of the invention and three exemplary reel "strips" which can be attached to reel 16-20 shown in Figure 1. Each of the reel strips contains a system of symbols and, in this example, there are five discrete physical stop positions at which one of the symbols is displayed. The symbols for each reel are assigned to unique terminal nodes in a fractional branching tree corresponding to each reel. In the illustrated embodiment, each reel displays one triple bar, one double bar, one single bar and two blank symbols.

[0049] Figure 11 is a table which lists the winning symbol sets that can be displayed on the payline 22 (Figure 1) for the reel strips of Figure 10. Also listed in Figure 11 are the number of physical reel stop combinations and the win percentages which correspond to the winning symbol sets. The odds of obtaining a particular symbol set are determined by assigning each symbol to a terminal node in a random number branching tree for each of the reels. The location in the tree determines the probability of the symbol being selected.

[0050] The probability of selecting a combination of three symbols is calculated by multiplying the odds for each reel. By way of example, the odds listed in Figure 11 are implemented by three iterations through the fractional branching tree 150 shown in Figure 12. It will be appreciated, however, that only one tree is necessary for the reels in the illustrated embodiment because each reel contains the same system of symbols. If multiple systems of symbols are used, then a separate fractional branching tree would be utilized for each of the different system of symbols.

[0051] Referring to Figure 12, fractional branching tree 150 includes a plurality of tiers 152, 154, 156 and 158 each having entries which lead either to lower tiers or to a terminal node. As with the first embodiment, it should be emphasized that each of the possible symbols is assigned only once in the tree structure and, therefore, to only one memory location in ROM 34 (Figure 3).

[0052] The probability for selecting each of the winning symbol sets, as listed in Figure 11, may be calculated from three iterations through the tree 150 (or through three separate trees if separate symbol sets are used) as follows. For each tier in tree 150, the number of terminal nodes associated with a particular symbol is divided by the number of terminal nodes in that tier. If the tree contains the same symbol at different levels, then this computation is repeated for each symbol, the results being summed to arrive at the odds of selecting that symbol for a particular reel. This process is repeated three times until a symbol is selected for each of the three reel strips shown in Figure 10. Finally, the numbers obtained from each iteration through the random number tree 150 are multiplied to compute the probability of obtaining a particular combination of symbols.

[0053] For example, the odds of obtaining three triple bars, is 0.000244. Referring to Figure 12, one triple bar is placed at tier 158 and, therefore, the odds of obtaining a triple bar on one reel is 0.5 x 0.5 x 0.5 x 0.5 = 0.0625. Thus, the odds of obtaining a triple bar on each reel equals (0.0625 x 0.0625 x 0.0625 = 0.000244). The odds of obtaining the blank symbol on one reel is (0.5 x 0.5 x 0.5 x 0.5) + 0.5 = 0.5625. Therefore, the odds of obtaining a winning combination of three blank symbols is (0.5625 x 0.5625 x 0.5625 = 0.177979).

[0054] Figure 13 is a computer flow diagram illustrating the operation of the alternate embodiment of the invention shown in Figures 10-12. As with the first embodiment, the random number generator function of microprocessor 26 is used to randomly select entries on the main tier of the branching tree corresponding to the first reel until a terminal node is reached (steps 160-174). The unique symbol assigned thereto is stored for display, step 176. Steps 160-174 are repeated for each of the reels of the slot machine, step 178, using the same or a different branching tree depending on the similarity of the reel strips. After symbols have been selected for all reels, the reels are spun and stopped to display that combination on the pay line and the appropriate payoff, if any, is determined and made, steps 180-186.

[0055] While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character. Thus, for example, larger reel strips can be employed and accommodated simply by expanding the tree structure.

Claims

1. A method of setting the probability of selection of symbol combinations to be displayed on the payline or lines of a mult-reel slot machine (10) in which each reel carries a specified set of symbols, characterised by:

   (a) providing a symbol look-up table in a memory device either for each reel or for a combination of reels, the or each look-up table being arranged in a tree branch structure (38, 150) containing tiers, each tier comprising nodes, each node comprising either a terminal node or a descending node which leads to a lower tier and at least one tier (44, 154) reached via a descending node from a higher tier (40, 152) said at least one tier (44, 154) also including a descending node leading to a lower tier (48, 156);
   (b) storing the symbol or symbols to be displayed in the corresponding look-up table at terminal node locations within the tree branch structure (38, 150); and
   (c) randomly selecting a single node in each tier which is reached, and controlling the reels to display the symbol or symbols stored in any selected terminal node, wherein the symbols are stored at terminal node locations corresponding to desired pay-off probabilities determined by the positions of the storage locations within the or each tree branch structure.

2. The method according to claim 1 further including the steps of:

   (d) randomly selecting a node in the first tier (40, 152) of said tree structure (38, 150);
   (e) determining if the selected node is a terminal node or a descending node;
   (f) in the event that a descending node is determined, dropping to the referenced lower tier (44, 154) in said tree and repeating steps (d) and (e) for such lower tier; and
   (g) in the event that a terminal node is determined, displaying the symbol or symbols stored at the terminal node for each reel or combination of reels.

3. The method according to claim 2 wherein step (d) comprises determining the number of nodes in the tier, N, and randomly selecting a number from 1 to N to select a node.

4. The method according to claim 1 or 2 wherein each tier in the tree structure (38, 150) corresponds to an order of magnitude less than the tier above it, thereby permitting accurate placement of symbol combinations within said tree structure to obtain the desired pay-off probabilities.

5. The method according to any of claims 1 to 3 wherein at least one tier in said tree structure (38) has 10 nodes.

6. The method according to claim 5 wherein the initial tier in said tree structure (38) has 10 nodes.

7. The method according to any preceding claim wherein at least some of the tiers in said tree structure (38) have different numbers of nodes.

8. The method according to any of claims 1 to 7 wherein each of said desired pay-off probabilities corresponds to a specific multi-reel combination of symbols to be displayed on said pay line.

9. The method according to claim 8 wherein said multi-reel combinations are grouped into multi-reel combination groups, each multi-reel combination in a particular group having an identical award associated therewith and a desired probability of obtaining that reward;
   wherein said step of storing said multi-reel combinations at terminal locations in said tree structure (38) comprises establishing the probability of reaching said locations and assigning the multi-reel combinations in a particular group to terminal locations such that the sum of the probabilities of reaching the locations associated with a particular multi-reel combination group is equal to the desired probability of obtaining the reward associated with said group.

10. The method according to claim 9 wherein at least one of said tiers in said tree structure has a sub-tier (51), linked via a descending node, which is not an order of magnitude less than the associated tier, said sub-tier (51) serving to permit the display of additional multi-reel combinations in a symbol group without alteration of the desired outcome probabilities.

11. A method according to claim 9 or 10 wherein the desired probability of obtaining the reward associated with said group is the number of multi-reel combinations in the group divided by the total number of possible multi-reel combinations.

12. A method according to any of claims 1 to 7 comprising one or more further trees (150), each of said trees corresponding to a reel on said multi-reel slot machine, each of said terminal node locations corresponding to one of said symbols on the associated reel.

13. A method according to claim 12, wherein each reel

contains a different set of symbols and a separate look-up table for each reel is stored in said memory device.

Patentansprüche

1. Verfahren zum Einstellen der Auswahlwahrscheinlichkeit von in der Zahlungszeile oder den Zahlungszeilen eines Mehrwalzen-Spielautomaten (10), bei dem jede Walze einen spezifischen Satz von Symbolen trägt, anzuzeigenden Symbolkombinationen, dadurch gekennzeichnet, daß:

   (a) in einer Speichervorrichtung entweder für jede Walze oder für eine Kombination von Walzen eine Symbolnachschlagetabelle bereitgestellt wird, wobei die oder jede Nachschlagetabelle in einer verzweigten Baumstruktur (38, 150) mit Ebenen angeordnet ist, wobei jede Ebene Knoten aufweist, wobei jeder Knoten entweder einen Endknoten (Terminalknoten) aufweist oder einen Abstiegsknoten, der zu einer niedrigeren Ebene führt, und zumindest eine Ebene (44, 154) aufweist, die von einer höheren Ebene (40, 152) aus über einen Abstiegsknoten erreicht wird, wobei die zumindest eine Ebene (44, 154) auch einen Abstiegsknoten umfaßt, der zu einer niedrigeren Ebene (48, 156) führt;
   (b) das anzuzeigende Symbol oder die anzuzeigenden Symbole in der entsprechenden Nachschlagetabelle innerhalb der verzweigten Baumstruktur (38, 150) an Orten von Endknoten abgespeichert werden; und
   (c) in jeder erreichten Ebene willkürlich ein einzelner Knoten ausgewählt wird und die Walzen so gesteuert werden, daß das oder die an einem beliebigen ausgewählten Endknoten abgespeicherte Symbol oder abgespeicherten Symbole angezeigt wird oder werden, wobei die Symbole an Orten von Endknoten abgespeichert sind, welche Orte gewünschten, durch die Position des Speicherortes innerhalb der oder jeder verzweigten Baumstruktur bestimmten Auszahlungswahrscheinlichkeiten entsprechen.

2. Verfahren nach Anspruch 1, das weiter die Schritte aufweist, worin

   (d) willkürlich ein Knoten in der ersten Ebene (40, 152) der Baumstruktur (38, 150) ausgewählt wird;
   (e) ermittelt wird, ob der ausgewählte Knoten ein Endknoten oder ein Abstiegsknoten ist;
   (f) in dem Fall, daß ein Abstiegsknoten ermittelt wird, zur genannten niedrigeren Ebene (44, 154) im Baum abgestiegen wird und die Schritte (d) und (e) für diese solche niedrigere Ebene wiederholt werden; und
   (g) in dem Fall, daß ein Endknoten ermittelt wird, das oder die am Endknoten für jede Walze oder Kombination von Walzen abgespeicherte/n Symbol/e angezeigt wird oder werden.

3. Verfahren nach Anspruch 2, wobei Schritt (d) ein Ermitteln der Anzahl von Knoten in der Ebene, N, und ein willkürliches Auswählen einer Zahl von 1 bis N zum Auswählen eines Knotens aufweist.

4. Verfahren nach Anspruch 1 oder 2, wobei jede Ebene in der Baumstruktur (38, 150) einer Größenordnung weniger als die darüberliegende Ebene entspricht, wodurch ein genaues Plazieren von Symbolkombinationen innerhalb der Baumstruktur zum Erzielen der gewünschten Auszahlungswahrscheinlichkeit ermöglicht ist.

5. Verfahren nach einem der Ansprüche 1 bis 3, wobei zumindest eine Ebene in der Baumstruktur (38) 10 Knoten aufweist.

6. Verfahren nach Anspruch 5, wobei die Anfangsebene in der Baumstruktur (38) 10 Knoten aufweist.

7. Verfahren nach einem der vorangehenden Ansprüche, wobei zumindest einige der Ebenen in der Baumstruktur (38) eine unterschiedliche Anzahl von Knoten aufweisen.

8. Verfahren nach einem der Ansprüche 1 bis 7, wobei jede der gewünschten Auszahlungswahrscheinlichkeiten einer spezifischen Mehrwalzenkombination von in der Zahlungszeile anzuzeigenden Symbolen entspricht.

9. Verfahren nach Anspruch 8, wobei die Mehrwalzenkombinationen zu Mehrwalzenkombinations-Gruppen gruppiert sind, wobei mit jeder Mehrwalzenkombination in einer bestimmten Gruppe der gleiche Gewinn und eine gewünschte Wahrscheinlichkeit, diesen Gewinn zu erzielen, verbunden ist;
   wobei der Schritt des Abspeicherns der Mehrwalzenkombination an Orten von Ausgangss in der Baumstruktur (38) ein Einrichten der Wahrscheinlichkeit, diese Orte zu erreichen, und ein derartiges Zuordnen der Mehrwalzenkombinationen in einer bestimmten Gruppe zu Ausgangsorten aufweist, daß die Summe der Wahrscheinlichkeiten, die einer bestimmten Gruppe von Mehrwalzenkombinationen zugeordneten Orte zu erreichen, gleich der gewünschten Wahrscheinlichkeit, den der Gruppe zugeordneten Gewinn zu erzielen, ist.

10. Verfahren nach Anspruch 9, wobei zumindest eine

der Ebenen in der Baumstruktur eine über einen Abstiegsknoten angebundene Unterebene (51) aufweist, die nicht um eine Größenordnung geringer ist als die zugeordnete Ebene, wobei die Unterebene (51) dazu dient, das Anzeigen zusätzlicher Mehrwalzenkombinationen in einer Symbolgruppe zu ermöglichen, ohne daß dadurch die gewünschten Ergebniswahrscheinlichkeiten geändert werden.

11. Verfahren nach Anspruch 9 oder 10, wobei die gewünschte Wahrscheinlichkeit, den der Gruppe zugeordneten Gewinn zu erzielen, gleich der Anzahl von Mehrwalzenkombinationen in der Gruppe geteilt durch die Gesamtzahl von möglichen Mehrwalzenkombinationen ist.

12. Verfahren nach einem der Ansprüche 1 bis 7, mit einem oder mehreren weiteren Bäumen (150), wobei jeder der Bäume einer Walze der Mehrwalzen-Spielmaschine entspricht, wobei jeder der Orte von Endknoten einem der Symbole auf der zugehörigen Walze entspricht.

13. Verfahren nach Anspruch 12, wobei jede Walze einen unterschiedlichen Satz von Symbolen aufweist und für jede Walze eine getrennte Nachschlagetabelle in der Speichervorrichtung abgespeichert ist.

Revendications

1. Procédé de réglage de la probabilité de sélection de combinaisons de symboles devant être affichés sur la ligne de paiement ou les lignes d'une machine à sous (10) à roues multiples, dans laquelle chaque roue porte un ensemble spécifique de symboles, caractérisé par :

   (a) l'instauration d'un tableau de verrouillage de symboles dans un dispositif de mémorisation, soit pour chaque roue, soit pour une combinaison de roues, le ou chaque tableau de verrouillage étant agencé dans une structure d'arborescence (38, 150) renfermant des rangées, chaque rangée comprenant des points nodaux, chaque point nodal comprenant soit un point nodal terminal, soit un point nodal décroissant qui gagne une rangée inférieure et au moins une rangée (44, 154) atteinte par l'intermédiaire d'un point nodal décroissant, à partir d'une rangée supérieure (40, 152), ladite rangée minimale (44, 154) englobant également un point nodal décroissant menant à une rangée inférieure (48, 156) ;
   (b) le stockage, dans le tableau de verrouillage correspondant, du symbole ou des symboles à afficher, en des emplacements de points nodaux à l'intérieur de la structure d'arborescence (38, 150) ; et
   (c) la sélection aléatoire d'un unique point nodal dans chaque rangée atteinte, et la commande des roues pour afficher le symbole ou les symboles stocké(s) à un quelconque point nodal terminal sélectionné, les symboles étant stockés en des emplacements de points nodaux terminaux correspondant à des probabilités de décaissement souhaitées, déterminées par les positions des emplacements de stockage à l'intérieur de la ou de chaque structure d'arborescence.

2. Procédé selon la revendication 1, comprenant en outre les étapes consistant à :

   (d) sélectionner aléatoirement un point nodal dans la première rangée (40, 152) de ladite structure d'arborescence (38, 150) ;
   (e) déterminer si le point nodal sélectionné est un point nodal terminal ou un point nodal décroissant ;
   (f) en cas de détermination d'un point nodal décroissant, redescendre à la rangée inférieure de référence (44, 154), dans ladite arborescence, et répéter les étapes (d) et (e) pour une telle rangée inférieure ; et
   (g) en cas de détermination d'un point nodal terminal, afficher le symbole ou les symboles stocké(s) au point nodal terminal pour chaque roue ou combinaison de roues.

3. Procédé selon la revendication 2, dans lequel l'étape (d) comprend une détermination du nombre N de points nodaux dans la rangée, et la sélection aléatoire d'un nombre compris entre 1 et N en vue de sélectionner un point nodal.

4. Procédé selon la revendication 1 ou 2, dans lequel chaque rangée de la structure d'arborescence (38, 150) correspond à un ordre de grandeur inférieur à la rangée susjacente, autorisant ainsi un positionnement précis de combinaisons de symboles, à l'intérieur de ladite structure d'arborescence, pour obtenir les probabilités de décaissement souhaitées.

5. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel au moins une rangée de ladite structure d'arborescence (38) comporte 10 points nodaux.

6. Procédé selon la revendication 5, dans lequel la rangée initiale de ladite structure d'arborescence (38) comporte 10 points nodaux.

7. Procédé selon une quelconque revendication précédente, dans lequel au moins quelques-unes des

rangées, dans ladite structure d'arborescence (38), comportent des nombres de points nodaux différents.

8. Procédé selon l'une quelconque des revendications 1 à 7, dans lequel chacune desdites probabilités de décaissement souhaitées correspond à une combinaison spécifique de symboles sur des roues multiples, devant être affichée sur ladite ligne de paiement.

9. Procédé selon la revendication 8, dans lequel lesdites combinaisons de roues multiples sont rassemblées en des groupes de combinaisons de roues multiples, chaque combinaison de roues multiples, dans un groupe particulier, présentant une récompense identique qui lui est associée, et une probabilité souhaitée d'obtenir cette récompense ;

dans lequel ladite étape de stockage desdites combinaisons de roues multiples, en des emplacements terminaux de ladite structure d'arborescence (38), consiste à établir la probabilité d'atteindre lesdits emplacements et à assigner, à des emplacements terminaux, les combinaisons de roues multiples dans un groupe particulier, de telle sorte que la somme des probabilités d'atteindre les emplacements, associés à un groupe particulier de combinaisons de roues multiples, soit égale à la probabilité souhaitée d'obtenir la récompense associée audit groupe.

10. Procédé selon la revendication 9, dans lequel au moins l'une desdites rangées de ladite structure d'arborescence présente une sous-rangée (51), rattachée par l'intermédiaire d'un point nodal décroissant, qui n'est pas un ordre de grandeur inférieur à la rangée associée, ladite sous-rangée (51) servant à permettre l'affichage de combinaisons additionnelles de roues multiples, dans un groupe de symboles, sans altération des probabilités de résultat souhaitées.

11. Procédé selon la revendication 9 ou 10, dans lequel la probabilité souhaitée d'obtenir la récompense associée audit groupe est le nombre de combinaisons de roues multiples, dans le groupe, divisé par le nombre total de combinaisons possibles de roues multiples.

12. Procédé selon l'une quelconque des revendications 1 à 7, comprenant une ou plusieurs arborescence (s) supplémentaire(s) (150), chacune desdites arborescences correspondant à une roue sur ladite machine à sous à roues multiples, chacun desdits emplacements de points nodaux terminaux correspondant à l'un desdits symboles sur la roue associée.

13. Procédé selon la revendication 12, dans lequel chaque roue contient un ensemble de symboles différents, et un tableau de verrouillage distinct pour chaque roue est stocké dans ledit dispositif de mémorisation.

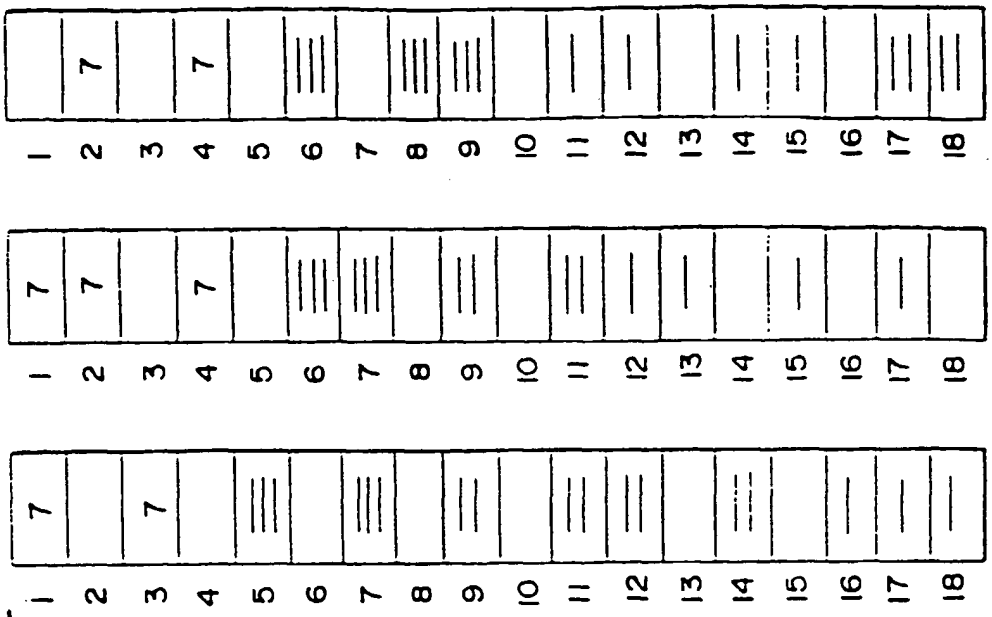

7
7
7
7
7
7
7
7
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

FIG. 2

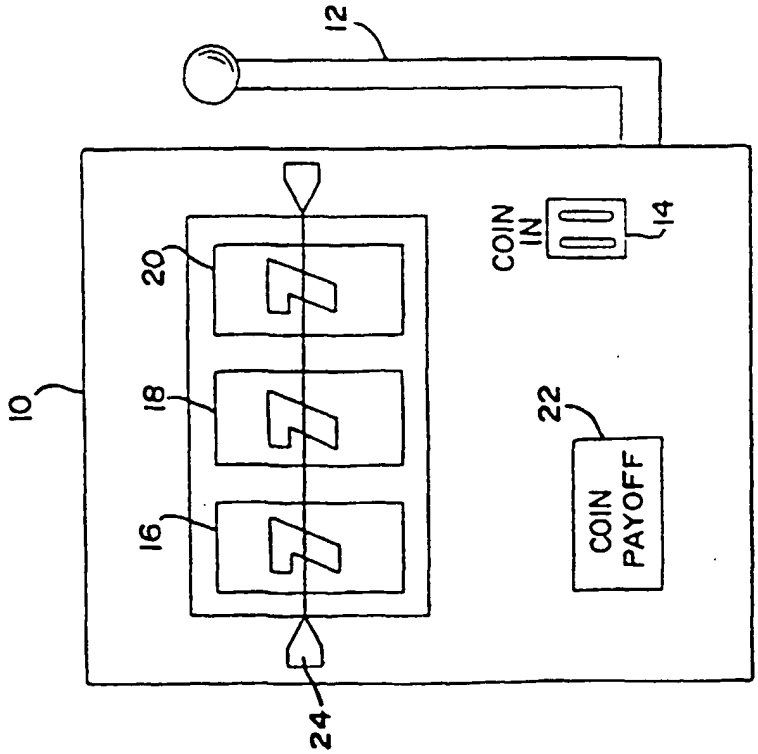

12
10
20
18
16
24
COIN IN
14
22
COIN PAYOFF

FIG. 1

FIG. 3

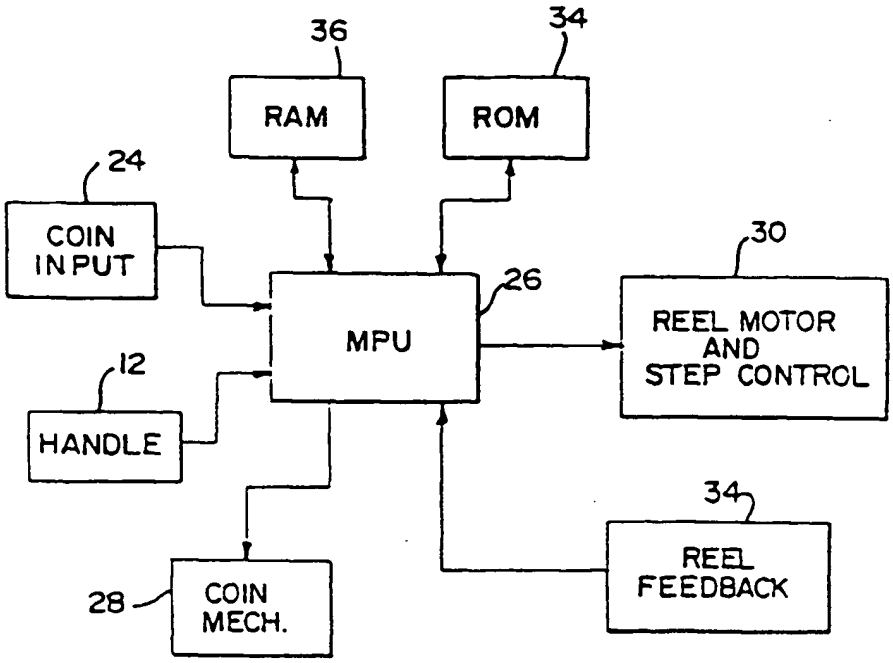


FIG. 4

	SYMBOL SETS	PAY	WAYS TO DISPLAY	DESIRED ODDS
A	7 7 7	200	12	.00028
B	☰ ☰ ☰	100	12	.00180
C	= = =	40	16	.00170
D	— — —	10	48	.01200
E	ANY BAR	5	572	.07500
F	3 BLANKS	2	343	.07000
G	LOSER	0	4,829 / 5,832	.83922 / 1.00000

FIG. 6

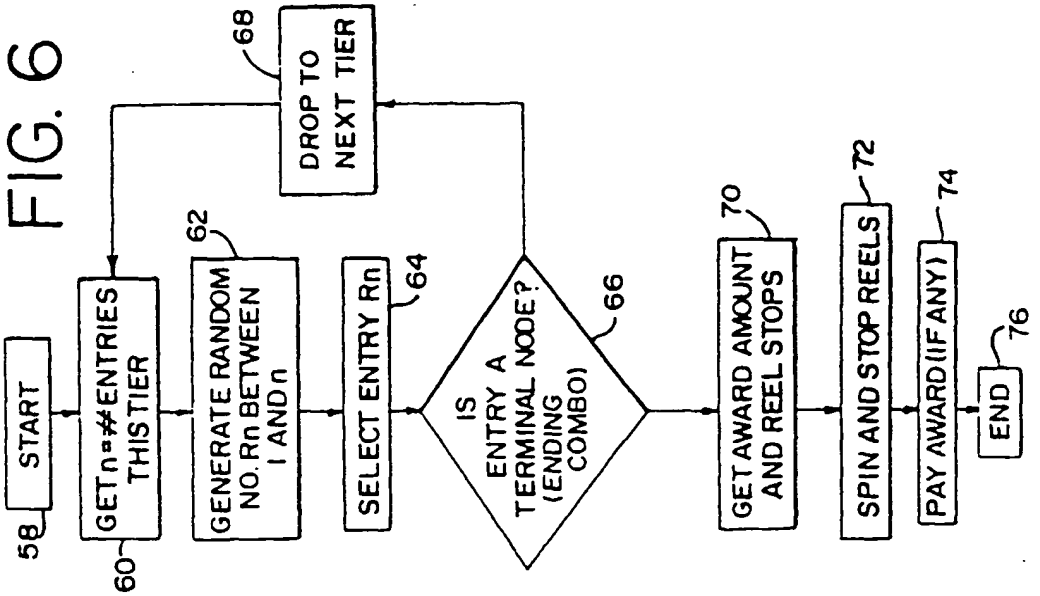

START
58
GET n = # ENTRIES THIS TIER
60
GENERATE RANDOM NO. Rn BETWEEN 1 AND n
62
SELECT ENTRY Rn
64
IS ENTRY A TERMINAL NODE? (ENDING COMBO)
66
DROP TO NEXT TIER
68
GET AWARD AMOUNT AND REEL STOPS
70
SPIN AND STOP REELS
72
PAY AWARD (IF ANY)
74
END
76

FIG. 5

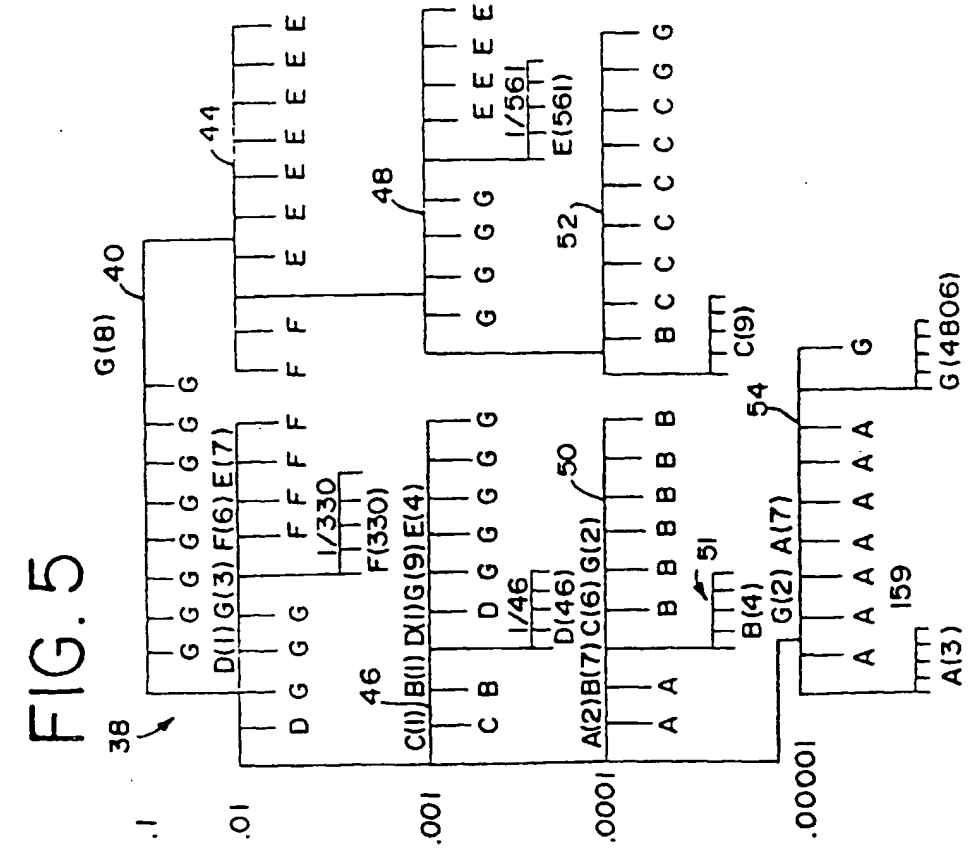

38
40
44
48
50
51
52
54
46
159
.1
.01
.001
.0001
.00001
G(8)
D(1) G(3) F(6) E(7)
C(1) B(1) D(1) G(9) E(4)
A(2) B(7) C(6) G(2)
B(4)
G(2) A(7)
1/330
F(330)
1/46
D(46)
1/561
E(561)
C(9)
G(4806)
A(3)

FIG. 7

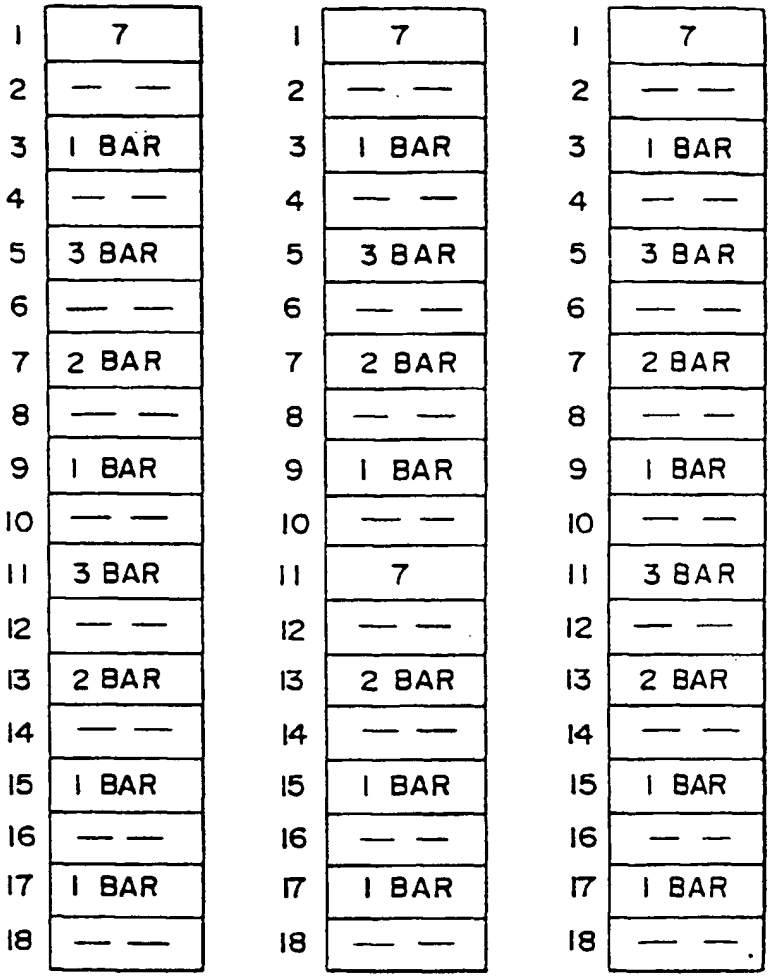
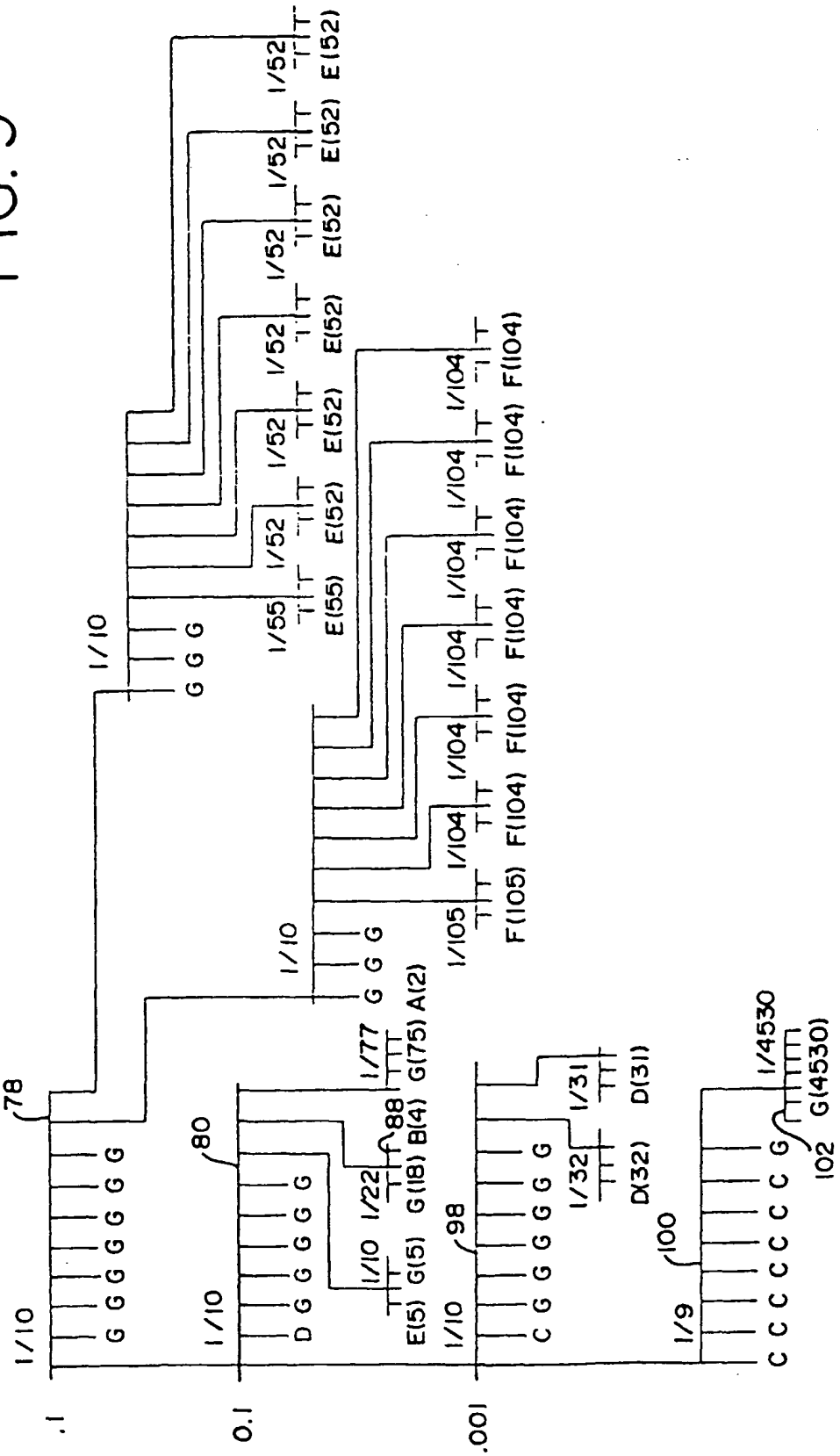


FIG. 8

	SYMBOL SETS	PAY	WAYS TO DISPLAY	DESIRED ODDS
A	7 7 7	200	2	.000260
B	= = =	100	4	.001818
C	= = =	40	8	.001777
D	— — —	10	64	.012000
E	ANY BAR	5	372	.075000
F	3 BLANKS	2	729	.070000
G	LOSER	0	4,653	.839144
			5,832	1.00000

FIG. 9


.1
0.1
.001
1/10
G G G G G G G
78
1/10
D G G G G G
80
1/10 1/22
E(5) G(5) G(18)
88
B(4)
1/77
G(75) A(2)
1/10
G G G
1/10
G G G
1/55 1/52 1/52 1/52 1/52 1/52
E(55) E(52) E(52) E(52) E(52) E(52)
1/105 1/104 1/104 1/104 1/104 1/104 1/104
F(105) F(104) F(104) F(104) F(104) F(104) F(104)
1/10
C G G G G G G
98
1/32 1/31
D(32) D(31)
1/9
C C C C C C C
100
1/4530
G(4530)
102

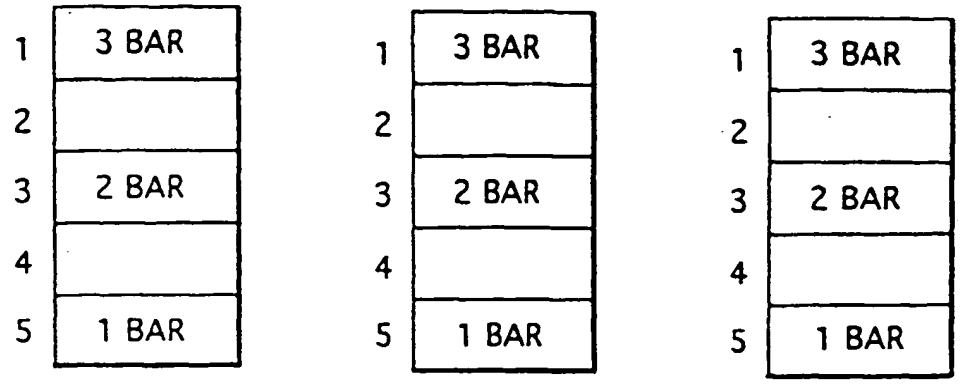


FIG. 10

SYMBOL SETS	PAY	WAYS TO DISPLAY	DESIRED ODDS
3 BAR 3 BAR 3 BAR	50	1	.000244
2 BAR 2 BAR 2 BAR	20	1	.001953
1 BAR 1 BAR 1 BAR	10	1	.015625
ANY 3 BARS	5	24	.065918
3 BLANKS	2	8	.177979
LOSER	0	$\frac{87}{125}$	$\frac{.738281}{1.000000}$

FIG. 11

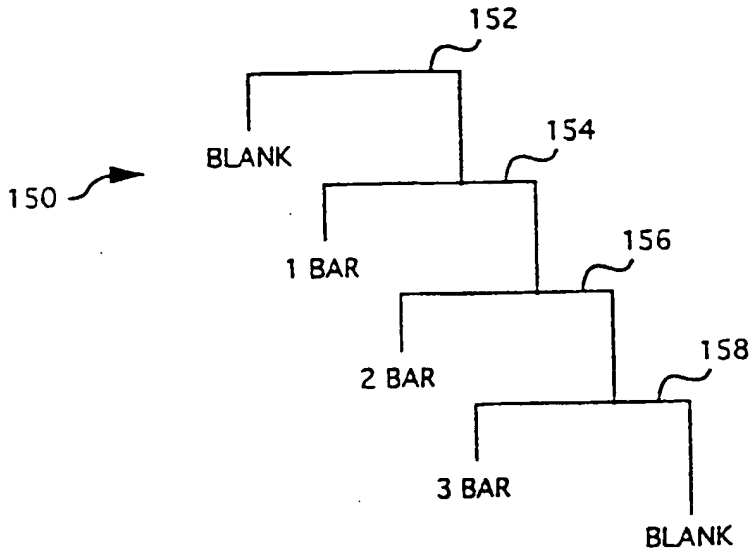


FIG. 12

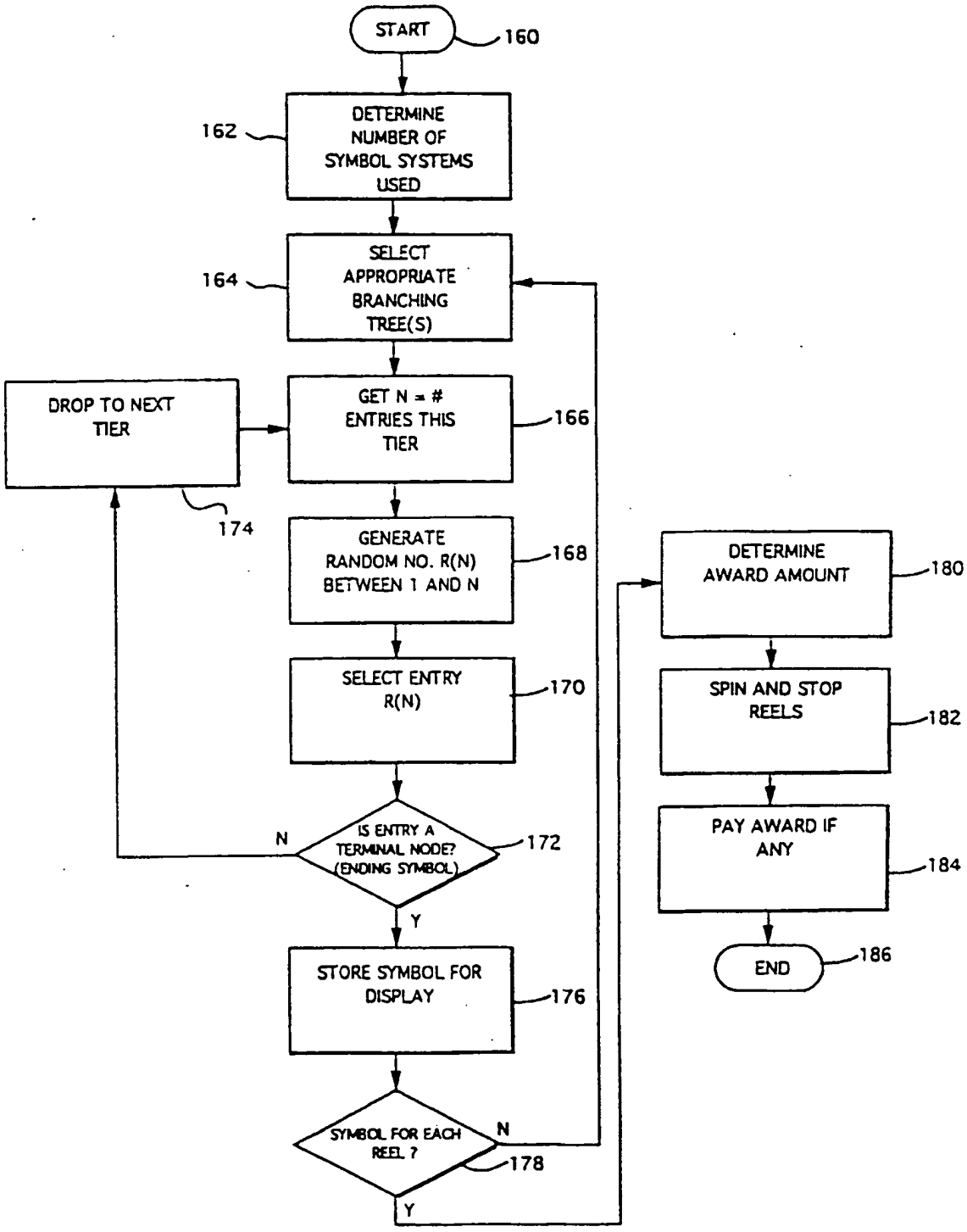

START
160
DETERMINE NUMBER OF SYMBOL SYSTEMS USED
162
SELECT APPROPRIATE BRANCHING TREE(S)
164
GET N = # ENTRIES THIS TIER
166
DROP TO NEXT TIER
174
GENERATE RANDOM NO. R(N) BETWEEN 1 AND N
168
SELECT ENTRY R(N)
170
IS ENTRY A TERMINAL NODE? (ENDING SYMBOL)
172
N
Y
STORE SYMBOL FOR DISPLAY
176
SYMBOL FOR EACH REEL ?
178
N
Y
DETERMINE AWARD AMOUNT
180
SPIN AND STOP REELS
182
PAY AWARD IF ANY
184
END
186

FIG. 13